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Drivers and Barriers of Lean Implementation in the Greek Manufacturing Sector

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Abstract

Lean manufacturing has evolved from a set of tools and techniques to become a management philosophy. It can be used to reduce waste and improve the efficiency of companies. Many companies worldwide have implemented lean management and achieved great improvements. The present paper focuses on the lean manufacturing implementation within the Greek manufacturing sector. The purpose is to determine the extent to which the main principles of lean manufacturing are understood and adopted in Greek manufacturing sector companies. Also this paper aims to assess the importance of the driving factors and barriers towards implementing lean manufacturing in the Greek environment. A structured questionnaire was developed and circulated to a large number of Greek manufacturing companies. Based on the literature review and questionnaire findings, the degree of implementing lean manufacturing in Greece is assessed and discussed against literature review findings.

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Keywords: Lean Manufacturing; Greek Manufacturing

1. Introduction

Lean manufacturing is a systematic approach for eliminating any type of waste from manufacturing operations. It was introduced in Toyota, initially referred to as Toyota Production System, and has evolved from being automotive focused to almost all manufacturing sectors. During the last decade a lot of attempts have been reported for applying lean in other sectors as well such as health care, services etc.

The introduction of lean however into manufacturing sector is not simple. Since lean is not only a set of tools to be used, but rather a new management approach (referred to as lean philosophy as well), a number of factors need to be considered when setting out to implement lean. A number of stakeholders, having conflicting interests, are involved that have to be considered in the process. The present paper addresses the implications of introducing lean manufacturing in Greek manufacturing sector.

Manufacturing in Greece traditionally was one of the key wealth factors. However, its contribution to the Gross Domestic Product (GDP) declined over the years, from 18% in 1991, to 14% in 2001. In 2014, the contribution to GDP was approximately 9.8%. Greece's manufacturing sector returned to growth in January 2014 after four consecutive years of recession [1]. As reported by Eurostat, manufacturing production in Greece averaged -0.78 percent from 1996 until 2015, reaching an all time high of 18.70 percent in March of 1998 and a record low of -16 percent in December of 2011 as a result of the financial crisis.

As a comparison, in the United Kingdom manufacturing production (as reported by the Office for National Statistics) averaged 0.60 percent from 1969 until 2015, reaching an all time high of 19.61 percent in February of 1973 and a record low of -16.96 percent in December of 1980.

The paper aims to assess the way lean manufacturing is introduced in manufacturing companies in Greece. Two objectives have been set: to describe and assess the introduction and implementation of lean manufacturing and the implications of this change to the organization; and to capture and assess the differences in the approach employed for lean manufacturing change in Greece compared to the literature review findings and assess the implications.

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2. Literature review on lean implementation frameworks

Implementing lean manufacturing is not a straightforward process. Unfortunately, there is not a recipe that if used can guarantee a successful implementation. Furthermore, unsuccessful implementation can have a great impact on organization's resources, but even more importantly, affect employees and their confidence in lean philosophy [2]. A number of "roadmaps" have been developed that can assist an organization transit from their existing operation to one that fully implements a lean philosophy.

One of the first roadmaps was proposed by Shingo [3], suggesting the key lean "elements" that should be implemented within one year. He identified 15 tools and techniques such as SMED, poke yoke, Kanban etc. to be implemented. Beck [4], in a similar way, suggested a 10-step approach focusing focusing in design and layout planning.

Anvari et al. [5] reviewed the existing lean roadmaps (studying 80 relevant publications) for similarities. They highlighted that the lean roadmaps studied indicate three major stages (preparation, design and implementation) composed of a number of "lean" steps. One of their main conclusions is that there is no unique roadmap to "leanness"; and that it needs to be tailored for every different organization to account for the specific conditions.

Lean Aerospace Initiative project developed the so called "Enterprise Level Roadmap" that can be followed by the senior management for the transition of the enterprise to higher levels of lean performance. The roadmap begins with a description of a top-level flow of primary activities. Subsequently, it provides descriptions of key tasks required within each primary activity and finally it leads to discussion of issues, enablers, barriers, case studies and reference material relevant to each task.

Mostafa et al. [6] also presented a framework for lean manufacturing implementation composed of four phases and 22 elements. The phases are defined as conceptual, implementation design, implementation and evaluation, and complete lean transformation phase. Monitoring and controlling are integrated to all phases to ensure that the expected results towards lean transformation are delivered.

Obviously, this is not an exhaustive list of the various lean implementation frameworks and models presented in the literature. Nevertheless, since the objective of the literature review is not to capture in full depth this topic, the aforementioned can be considered as representative and serve for reaching conclusions. However, it should be noted that a number of lean implementation models have been also developed outside academia, mainly by consultancy firms. Indicatively, two will be presented hereafter.

Wright [7] presented a twenty-step implementation plan in the form of a roadmap, mentioning though that it is not to be adapted as-is but requires tailoring to the specific needs of the organisation undergoing the lean change. However, he mentions that there is a logical sequence to many of the tools. Value stream mapping is almost always conducted very early on in the process. The 5-S system provides a foundation for most other tools. TPM is key and plays an important role in OEE improvement and, therefore, must be started early.

Surveys in various countries with regards the success of lean implementation, the critical success factors and the barriers have been reported. Lean implementation studies were found in the literature from 16 countries. However, there has not been any study of lean implementation focused in Greek manufacturing sector. As it has been highlighted in the introduction, implementation of lean in Greek manufacturing sector could potentially be one of the solutions that will allow the sustainability of the sector under the austerity measures. The study of the relevant surveys in other countries allowed for commonalities to be identified, and the key lean practices, success factors and barriers were identified for providing the basis for the formulation of the questionnaire.

Limited number of studies on lean manufacturing implementation failures are reported, mainly due to the fact that companies wish to protect and not disclose their investments that failed. However, it is an accepted fact that many implementations do fail. In the few studies found about failing implementations, the common root causes are related to: lean suppliers; leadership; employee involvement; tools and techniques; and business systems.

The barriers in the implementation of lean manufacturing, can be linked to management, lack of necessary resources, resistance to change etc. Management can be both a barrier but also a driver for lean implementation. When considering management as a barrier, this is related to specific attitudes and behaviours such as exerting lack of focus for supporting lean manufacturing initiatives, failing to create urge of urgency, and does not have long term vision, to name few. Lack of necessary resources prohibit the implementation of lean manufacturing. A number of companies rely on consultants for introducing lean, thus resources for consultancy are key. The quality of the consultant is critical, and in many cases superficial knowledge of the subject and lack of implementation practice results into confusion about lean manufacturing and can become an obstacle in implementation. Absence of knowledge on lean philosophy and the various tools can be a great barrier in the implementation. Resistance to change by the employees is a common barrier as well. This resistance can be rooted to the fear of the unknown, fear of failure and complacency.

Fig. 1. Lean manufacturing tools and practices.

The literature review was focused on identifying the status of lean, the various tools and practices, the drivers and finally the barriers. Many similarities can be identified between the researchers, and although in some cases there is difference in the terminology, the semantics are the same.

Key lean manufacturing tools and practices

The lean manufacturing practices and tools shown in Fig. 1 have been highlighted by most of the researchers. Obviously the list is not exhaustive, but the focus is on the ones that are most widely discussed in the academic sources.

Key drivers for implementing lean manufacturing

The key drives for a company to engage into lean manufacturing that have been highlighted by most of the researchers are summarized into the following list.

- To increase market share
- To increase flexibility
- The need for survival from internal constraints
- Development of key performance indicators
- Desire to employ world best practice
- Part of the organisation's continuous programme
- Drive to focus on customers
- Requirement/Motivation by customers
- Requirement by mother company

Key success factors

The literature review revealed a wide range of factors related to the successful implementation of Lean, that are summarized into:

- Organisational culture and ownership
- Developing organisational readiness
- Management commitment and capability
- Providing adequate resources to support change
- External support from consultants in the first instance
- Effective communication and engagement
- Strategic approach to improvements
- Teamwork and joined-up whole systems thinking
- Timing to set realistic timescales for change and to make effective use of commitments and enthusiasm for change

Key barriers that prohibit implementation

The grouping of the barriers / obstacles that prohibit the implementation of lean manufacturing is presented in Fig. 2.

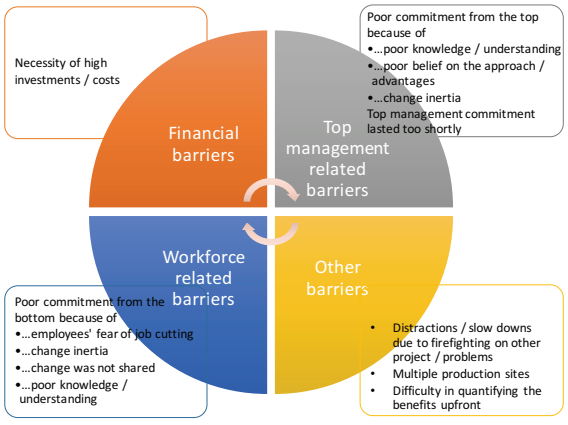

Fig. 2. Lean barriers.

3. Research Methodology and Data Collection

The questionnaire was developed based on the literature review findings in order to assess whether such findings apply to Greece as well. The questionnaire consisted of three parts. The first part was designed to collect information of personal information, the second part was designed to collect general information of each company, the third part was designed to assess the understanding of lean, the attitude toward lean implementation and the problems and barriers.

Parts one and two consist of four questions each. Part three consists of nine questions (a mix of multiple choice and Likert type ones). Depending on the content of the questions, some were setup on a Likert scale. The scale was ranged from 1 to 5 representing the perception levels ranging from totally disagree to totally agree for positive questions, and vice versa for negative questions. The result would be interpreted according to three classes of average score; 1 – 2.33, 2.34 – 3.67 and 3.68 – 5.00 as negative, neutral and positive perception for each item.

60 questionnaires were emailed to operations managers and manufacturing engineers of different companies in different sectors (including defence, aerospace, consumer goods, etc. both public and private). 31 completed questionnaires were received (51% response ratio). Out of the respondents, 49% were from companies within the consumer goods manufacturing sector, 19% from pharmaceutical sector, 10% from defence sector, 3% from aerospace sector and 19% from other suppliers. With regards the company size, 45% were from companies with 10 to 50 employees, 48% with 50 to 250 employees, and only 7% from larger companies. 35% of the responds were from companies that are subsidiaries of larger international companies.

4. Discussion of Results

4.1. Lean implementation

Two questions were aimed at identifying the level of lean implementation maturity and whether there are different ways of introducing lean in the company. From the respondents, 48% have been implementing lean initiatives for more than three years. With regards the way the lean was introduced in the companies, most of the companies (68%) introduced lean by training the existing personnel in lean manufacturing and techniques, whereas the rest of the companies used an external consultant. In contrast, literature indicated that in many cases lean was implemented by employing an expert in lean for bringing about the change in other countries, a practice that is not adopted in Greece.

4.2. Lean understanding

A number of questions were designed to assess the level of understanding of lean manufacturing principles and about the specific methods used for the lean implementation. The association of lean manufacturing with key objectives / ideas was first assessed. The first ranked association was "waste reduction" followed by "a set of tools for production

improvement" and "continuous improvement". Both continuous improvement and waste reduction are principles utilized by lean manufacturing, and obviously the respondents emphasize on these two. Characterizing though lean manufacturing as a "set of tools", does not allow for lean manufacturing to show all its potential. This is also evident by the fact that the response "A management philosophy" was selected by only 10%, indicating that lean understanding is not yet that mature. Interestingly, only 13% associated it with the TPS which is the root of lean manufacturing. Finally, it is interesting to note that 39% of respondents in Greece associate lean manufacturing with workforce reduction. This perception is negative and in contrast to lean manufacturing core principles. Furthermore, this can be a barrier to lean manufacturing implementation and needs to be addressed.

The level of understanding was not found to vary with the company size. However, it depends on how long the company is implementing lean. Companies with more than three years focus more on the continuous improvement and management philosophy aspects of the lean manufacturing. Companies with less than three years focus on the waste reduction and the set of tools for production improvement. Only responses from companies with less than one year indicate that lean might be associated with an attempt to reduce the workforce. This reflects the way the understanding of lean evolves as companies' progress in their lean journey.

As a follow up to the general understanding of lean manufacturing, the specific techniques and practices and their understanding were assessed. A number of techniques were asked to be assessed in terms of familiarity of respondent and whether they feel confident in applying these techniques within their own company. Since the questions were set in a Liker scale, the quantification of the responses was possible. The scale ranged from 1 to 5 representing the perception levels ranging from "Not clear what it is" to "Considered to be a Champion!". SMED and 5S rank first. This is agreement with the findings of the literature review in other countries, mainly because of the fact that these are usually the first techniques to be implemented in a company were lean is introduced. Other lean techniques and practices such as Kaizen, identification of waste, preventive maintenance, value stream mapping (VSM), etc. are well understood compared to the rest of the lean techniques. However, the techniques that aim to improve customer / client involvement and employee engagement are not that well understood and thus adopted.

Due to the big number of different techniques, general conclusions cannot be easily reached. Panizolo [8] categorised the lean practices into five categories: process and equipment, manufacturing planning and control, human resources, supplier relationships, and customer relationship. Fig. 3 illustrates the distribution of mean scores for each of the category. The process and equipment presents the highest score for understanding. Especially, with regards the supplier and customer relationships, the Greek respondents are not confident with their understanding of such lean tools. These findings are in agreement with the results presented by Panizzolo [8] where it was showed that many firms seem to have difficulty in adopting lean tools that concern with external relationships such as with suppliers and customers.

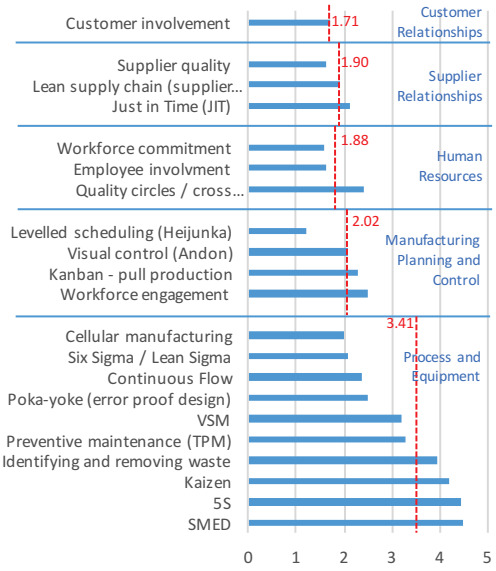

Fig. 3. Lean techniques understanding.

4.3. Lean diffusion

Further to lean understanding, the level of implementation was investigated. The same lean techniques were asked to be ranked with regards their implementation to those that the companies "already implement/have implemented", those that they "will implement in the close future", and those that they "do not foresee to use in the close future". The quantification of the responses was based on the mapping of the responses to the Likert scale. The average value for each technique is presented in Fig. 4. The lean techniques that scored the higher in terms of their implementation are 5S, SMED and Kaizen. It is obvious that the techniques that are related to "process and equipment" are mostly implemented, that is in agreement with the level of understanding. The least practiced lean tools are the "levelled scheduling" and "cellular manufacturing".

4.4. Lean drivers

In the literature review, the main drivers that promote the implementation of lean in companies have been identified. The extend of each one of these drivers was assessed through the questionnaires. The respondents were asked to select up to three from the list of drivers that were identified (Fig. 5). The key driver revealed to be increasing the market share. The organizations strive for continuous improvements was the second. Other key drivers are the desire to employ world best practice and the need for survive. Interestingly, the drivers related to customers were ranked low, in agreement to the understanding of lean depicted in the previous section. This is quite different to findings in other countries (for example in Italy [9]). Requirement by the "mother" company was raised by 33% of the respondents, however this question is applicable only to companies who are subsidiaries, and in that case almost 90% identified it as a driver.

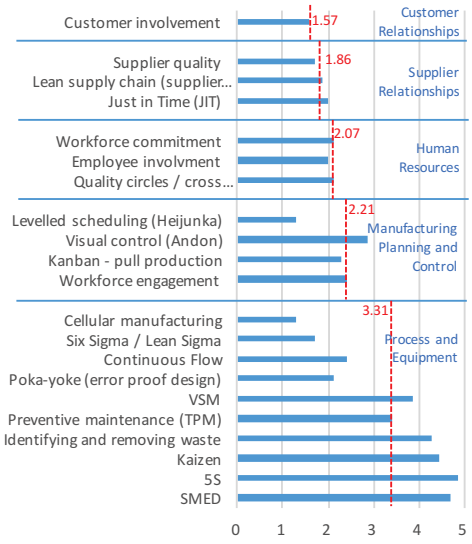

Fig. 4. Lean techniques implementation.

4.5. Lean barriers

The barriers identified in literature review were assessed. A number of statements were posed and the respondents were asked to indicate whether they agree or disagree in a Likert scale. The average value for each technique is presented (Fig. 6). One of the main causes in deploying lean manufacturing projects has to do with the everyday problems (Distractions / slowdowns due to firefighting on other projects / problems). In order of importance, workforce related barriers are the most critical ones with top management related ones coming second. Additionally, financial barriers are highlighted as key for Greek manufacturing companies, that can be associated with the financial crisis that has been going on for the last five and the liquidity problems that most of the Greek manufacturing companies face.

The lean barriers were also analysed with regards the lean implementation maturity (implementing for less than a year, for between 1 and 3 years and for more than three years). Most of the companies at the starting of their lean journey indicate that the key barrier is workforce understanding and commitment to lean, and as they progress, the key problems become more related to the top management commitment and the availability of resources (fig. 7).

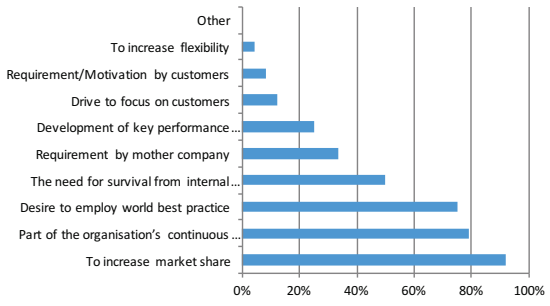

Fig. 5. Lean drivers at Greek manufacturing companies

5. Analysis of findings

In order to investigate the differences between the findings in the Greek setting and what literature review indicates for other countries, the results were discussed with three lean experts with more than 20 years of experience in both UK and Greece. All three interviews were open ones based on the "5 whys" approach for identifying the root causes.

The interviews converged to the same key issue: the fundamental reason why the implementation of lean is so challenging is related to the company's culture. Culture, in the sense used, is an anthropological term that defines the individuality or uniqueness of a society, organisation or social group. The culture of any organisation is dynamic and will be in a state of constant change. It will also be created at any point in time by any number of subcultures, which may be competing, shared and more or less dominant. Deal and Kennedy [10] argue that culture is the most important factor accounting for success and failure of organisations.

Thus the key reasons that prohibit the implementation of lean in Greece in order of importance were identified and presented in the following paragraphs.

Employees engagement and commitment to change

As shown in Fig. 6, the most prominent barriers are related to workforce issues. The respondents identified workforce engagement and commitment due to a number of reasons such as fear of losing their job, inertia to change, lack of understanding of the need for change and of knowledge on the actual tools to be used. However, the participation of the workforce is critical for the successful implementation of such programmes, since the operators for example in the shop floor are the ones who have the more complete knowledge of the activities and tasks to be undertaken. The engagement of the employees can be enhanced by inviting them to take active role in the decision making for such project's initiation.

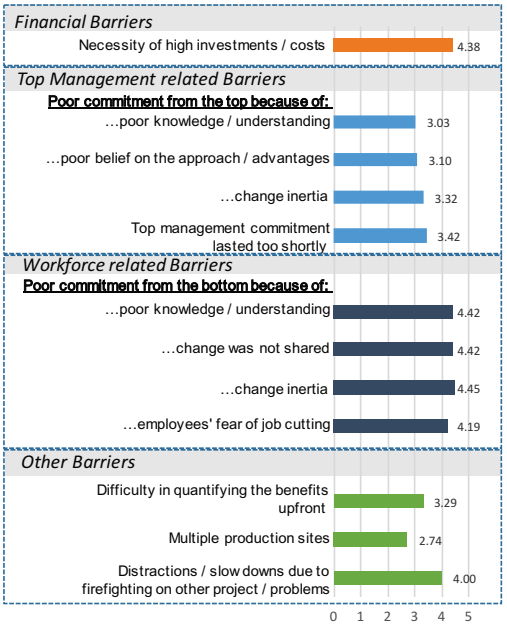

Fig. 6. Lean barriers for Greek manufacturing companies

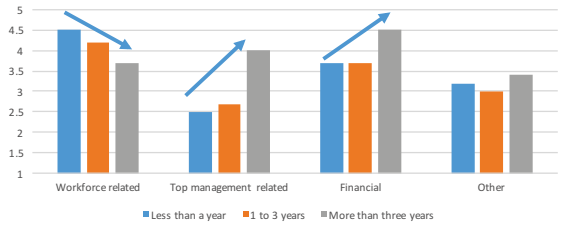

Fig. 7. Evolution of the perception on lean barriers

Lean understanding within the companies

Greek manufacturing companies exhibit a different understanding to lean compared to the literature review findings. This misunderstanding spans both in management teams and the employees within Greek companies. It is not possible to have commitment from high management and workforce on something that they do not really understand. Training on lean is critical for overcoming this challenge.

Lack of lean training

As a follow up to the previous point, training is essential for bringing both management and workforce up to speed with lean. The extend of this training, the focus and the breadth of content needs to be tailored to the needs and the function of the trainee. A different type of training is required for the management to that of an operator of a machine.

Leadership commitment and engagement

The top-management commitment and involvement was highlighted as critical. During the three interviews it was also discussed that strong commitment required by the leadership for a successful implementation. McMahon [11] suggests that leadership needs to be "firm and inspiring, relentless and resilient, demanding and forgiving, focused and flexible". The strategy needs to be clear with regards the vision and the direction of the company. The responsibilities and authority of lean engaged personnel, the resources to be committed, the key performance indicators to be employed, the deliverables and milestones of the implementation need to be defined.

Customer focus

From the responds, it was evident that the relationships with the customers is not up to the expected level. The focus of lean is on cost reduction for internal reasons. However, customer focus is one of the key principles, and the full potential of lean can be revealed only through more structured and better customer engagement.

Lean introduction method

The literature indicated that in many companies the introduction of lean was based on employing a lean expert. That is not a common practice in Greece. Relying on an external expert can have many advantages, such as the fact that someone is bringing her own knowledge and experience and can help implement lean. However, the implementation cannot rely only in one person, a critical mass of knowledgeable personnel is required for spreading the knowledge to the whole company. Furthermore, it is important that they are part of the company, the rest of the personnel feel comfortable with them and they know and understand the culture of the company. Relying solely on an external expert can be an issue, as she is not necessary aware of the differences and the unique characteristics that the company exhibits. Furthermore, there is always the danger of the external expert to try to copy the implementation plan that may have worked in another company. However, for being successful in the implementation of lean tools, these must be closely related and tailored to the philosophy and culture of the company.

6. Conclusions

The paper's aim was to assess the way lean manufacturing is introduced in manufacturing companies in Greece. For fulfilling this aim, two objectives were set.

The first objective was to describe and assess the introduction and implementation of lean manufacturing and the implications of this change to the organisation. The implications of the introduction of lean to organisation culture were discussed as well as the key factors and the main barriers when implementing lean manufacturing.

In order to to capture and assess the differences in the approach employed for lean manufacturing change in Greece compared to the literature review findings in other countries and assess the implications a questionnaire was developed and circulated in manufacturing companies. The analysis of the questionnaires revealed the level of understanding, the key barriers and drivers behind lean implementation success. The results were discussed with experts in order to understand and document the root causes behind these differences.

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